DOCUMENT RESUME

ED 030 391 HE 000 963

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Budget Formulas and Model Building.

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Pub Date 6 May 68

Note-15p.; Paper presented at the 1968 Association for Institutional Research Forum, San Francisco, California, May 6-9, 1968

EDRS Price MF-$0.25 HC-$0.85

Descriptors-*Budgeting, *Educational Finance, *Financial Policy, Higher Education, *Models, Program Budgeting, *University Administration

Selected budget formulas currently in use for university operations are described as a background for examining a budgetary model that would provide for the integration of separate formulas. Data on the formulas were collected from states with system-wide coordinating boards that are responsible for budgetary reviews. The most common formula relates faculty positions in some way to the number of students, but some do not recommend the appropriate numbers of necessary support personnel. Most salary requests are related to the regional or national academic market, but 1 board in a state with a high per capita income recommends "target salaries" that are based upon the midpoint between "A" and "AA" on the AAUP compensation scales plus fringe benefits at 8% of salary. Libraries are being justified by boards that have adopted the Clapp-Jordan formula guidelines, which include faculty size, number of students, and the numbers and nature of fields of study at various levels of instruction. Formulas for maintenance are related to gross square or gross cubic footage. It is felt that unconnected formulas could be integrated through or replaced by a model that would simulate the total instructional program. This model would identify the allocation of resources as a total package rather than as separate units, and may be more appropriate for techniques of program budgeting than are formulas. (WM)

Presented at the 1968 Association for Institutional Research Forum
San Francisco, California, May 6-9

ED 020971

BUDGET FORMULAS AND MODEL BUILDING

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This paper describes selected budget formulas currently used by states with system-wide coordinating boards. The descriptions, rather than being exhaustive, are merely intended to give examples of developments in this area as a background for examining a budgetary model. The model gives a conceptual framework for the integration of these formulas. And because of the limitations of formulas the model is recommended as a device to replace these formulas.

Procedure

Data were obtained during February and March 1968 from the twenty-seven coordinating boards identified by Williams (1967) as having, among other functions, that of budgetary review. Each board provided documents describing the formulas, if any, used in the preparation of consolidated budget requests. The descriptions were taken from these documents. In order to guarantee the confidentiality of the response, specific states are not identified.

In selecting the states and formulas to concentrate upon, it was decided not to emphasize those states that are already adequately described in the literature (Miller, 1964; WICHE, 1959). Furthermore, to give focus to this presentation, the discussion is limited to formulas relative to University operation. Some states justify different formulas for different segments (universities, colleges, etc.) of the system. However, by examining the more complex university level formulas, judgements can be made about appropriate formulas for the other, less complex, segments in higher education.

The examples are presented by function (library, maintenance) rather than by the customary category of state in order to stress the type of formula. And the focus will be on the common elements of operation, rather than special programs: museums, colleges of medicine, schools for the handicapped, and so on.

HE000 963

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These formulas should generally be thought of as request formulas rather than appropriation formulas since they are administered for the most part by the coordinating boards in making representation before state officials on behalf of the institutions.

And finally, it cannot, it seems, be stressed too often, that because of the marked differences of practice concerning the definitions and procedures employed among states any figures or ratios must be interpreted only as guidelines to informed judgement.

Staffing

The most common formula relates faculty positions in some way to the number of students. Table I illustrates the ratio of students per faculty position at four levels of instruction for the eight coordinating boards whose data were already in or could be interpreted to be student-faculty ratios. The numbers in the table represent students per faculty position. These data indicate that there is substantial agreement among states with recommended student-faculty approximating: 23:1 lower-division, 17:1 upper-division, 12:1 masters, and 6:1 doctoral.

Table I about here

These data can be translated into credit hour, class size, and teaching load figures by the application of program assumptions. For example, state A's lower division ratio of twenty students to one faculty position, assumes an average of twenty-five students per class and twelve class hours per faculty member, resulting in 300 student credit hours (25 x 12 = 300). The ratio of students to faculty will, obviously, depend on assumptions of faculty service (work load).

Other staffing formulas cannot be summarized as easily. A coordinating board in an eastern state recommends the following standards for support personnel:

(a) Two clerical positions for each dean's office.
(b) One clerical position for each department chairman.

(c) One clerical position for each four faculty members.

(d) One laboratory assistant for each fifty laboratory student stations.

Another coordinating board (southern) recommends one administrative position to 7.3 teaching positions, and other non-academic positions at the rate of one to ten academic positions. A second southern board recommends a university-wide ratio of one non-faculty position per three faculty. Neither board offers clear definitions of what constitutes a non-academic position. Does it include student help, technicians, deans, etc.?

These boards are, however, unusual in their detailed specifications. The majority of documents do not proport to be able to identify the appropriate numbers of support personnel that are necessary. Instead, dollar amounts, usually as a percentage of a base instructional cost are identified for such "overhead" items as personal (i.e., clerical, teaching and laboratory assistance) departmental, central administration, or student personnel services. Specific positions, especially administrative, are determined through means of representation other than the budget request.

Salaries

Most salary requests are related to the academic market, either regionally (New England, 11-state midwestern area, Big Ten) or nationally (AAUP). An illustration of the first approach is a midwestern state that has adopted a "3rd place concept."

> "Salaries paid to professors, associate professors, assistant professors, and instructors in the various colleges of the universities are secured and ranked from high to low. The institutions feel that they can be competitive if their salaries can be at a point midway in the upper half of the ranking by college and rank. Using this approach, each institution computes its needs for academic salary increases on the basis of its current salaries compared with the 3rd place salaries in the 11-state area. This calculation includes the amount needed to get to 3rd place, and stay there during the next biennium ..."

The second approach is illustrated by a coordinating board in one of the states with a high per capita income. This board recommends "target salaries" that are based upon the midpoint between the "A" and "AA" on the

AAUP compensation scales plus fringe benefits at 8% of salary. Table II illustrates this boards target salaries (not including compensation) by rank and the related AAUP salary midpoints, which include compensation.

Table II about here

Libraries

This major budget item, usually separately identified, is being justified increasingly by detailed quantitative methods (McAnally, 1963). Rather than the more conventional, but somewhat arbitrary, Russell-Doi percentile breakdowns or rates per credit hour, a substantial number of state coordinating boards are adopting the guidelines of the Clapp-Jordan formula, because it includes such elements as faculty size, number of students, and the numbers and nature of fields of study offered at various undergraduate, graduate and professional levels of instruction. The formula is a study in itself and the reader is referred to Clapp and Jordan (1965) for details.

Maintenance

Guidelines or formulas for maintenance are always related to either gross square or gross cubic footage. The definition of "maintenance" varies substantially and thus comparisons are nearly impossible. There are, however, certain figures that are repeated from state to state and seem to have reasonable validity. When maintenance is defined as custodial work, a cost per square foot of between $.18 and $.25 tends to emerge with relative consistency; when, however, the definition of maintenance involves more than custodial care but is related to repairs and renovation or operation (heating, lighting) then the cost per square foot or cubic foot is most often between $.90 and $1.50. These are, at best, rules of thumb.

Institutional Complexity

Several states have studies, are studying, and have applied weightings or factors to levels of instruction, often by areas of knowledge, in order to give additional weight to budgetary requests from institutions with, for example, proportionately larger graduate programs.

The most detailed of these formulas, used to request funds for or-

ganized research, is from one of the western states:

$$IC = \frac{.015U + (.50M_1 + .10M_2 + .25M_3) + (6D_1 + 1D_2 + 3D_3)}{U + M + D}$$

where:

IC = Institutional Complexity
U = Undergraduate FTSE
M = Masters FTSE
  M_1 = Masters FTSE in Science and Engineering
  M_2 = Masters FTSE in Teacher Education
  M_3 = Masters FTSE in all other programs
D = Doctoral FTSE
  D_1 = Doctoral FTSE in Science and Engineering
  D_2 = Doctoral FTSE in Teacher Education
  D_3 = Doctoral FTSE in all other programs
FTSE = Full Time Student Equivalent

Several states use similar factor weights, largely reflecting faculty workload by levels of instruction; these factors are used for purposes ranging from determining merit pay (by rank) to allocating general instructional costs.

Table III about here

Table III illustrates factor weights from three states. It seems to be generally true that a ratio of about 1:3 exists between the lower division and graduate programs. Another way of looking at this ratio is to say, for example, that for each unit of a resource required per student credit hour at the lower division level will require three units at the graduate level.

Limitations in the Use of Formulas

These formulas at best serve as rough guides to existing quantitative relationships. They do not, of course, recognize even subtle variations that exist among areas of study or institutions. They are only meaningful when related to other information. And they do not serve as ultimate criteria, only as norms.

There is a danger that formulas will get accepted, without question, no matter how bad, because of superficial validity. And after acceptance, the experience has been that they grow continually more rigid and detailed.

Furthermore, in all approaches to request and appropriation formulas

there is always the danger that those aspects of higher education necessary to the creation and maintenance of the complete intellectual environment will be omitted from the formula, items such as museums, art collections, counseling, faculty research, and so on.

Some feel the formulas, at best, merely bring out of chaos, confusion. Some of this confusion can be reduced by the use of common, or at least more complete definitions. Recommended are the detailed definitions worked out in two states: Illinois Board of Higher Education (1966) and Coordinating Board, Texas College and University system (1966). Interstate studies providing guidelines to appropriate definitions are Miller (1964) and Swanson, Arden and Still (1966). Complete citations are listed with the references.

Another way of reducing the confusion is to integrate the usually discrete and unconnected formulas. This can be accomplished through a "model" that simulates the instructional process. Figure A suggests that the required resources are a function of the level of instruction and the area of knowledge, i.e., the application of resources (laboratories, library, faculty, maintenance, etc.) depends upon the area knowledge under consideration and the level of teaching.

Figure A about here

Table IV is a somewhat detailed expansion of Figure A in the form of a matrix where each cell encompasses a relationship between a level of instruction and an area of knowledge. These cells are the important aspect of the matrix, because within each cell a model can be built to describe the deployment and cost of resources necessary to operate an instructional program at the "intersection" of knowledge and instruction. Take the lower-division social sciences as a first example (Cell A). Figure B illustrates the resources necessary for 1000[1] students.

Figure B about here

Compare the model of Cell A with Cell B: upper-division social sciences. In Cell B, assume a higher average faculty compensation because these are for the most part higher ranked faculty, thus higher salary. Classes

[1]These data were from Ohio Board of Regents, Recommended Operating Support 1967-1969, January 1967, pp. 31-32. This document illustrates the use of several models.

will be smaller, therefore, more faculty are necessary. And other expenses are, likewise, higher. The result is that the deployment of resources (e.g., faculty) change from cell to cell, resulting in a different model for each relationship. The total instructional program can in this way be simulated cell by cell.

Figure C about here

The major benefit of the model approach seems to be a meaningful integration of data. These data are in the form of a program which identifies the allocation of resources as a total package, rather than as separate parts: the model vs. the formula. An additional benefit is that the model may be more amenable to the techniques of program budgeting than are formulas. These suggestions may indicate the usefulness of such exploration.

Table I

FTE STUDENT ENROLLMENT
REQUIRED PER FACULTY POSITION

State	Levels of Instruction			
	Lower Division	Upper Division	Masters	Doctoral
A*	20	12	7	5
B**	24	16	12	6
C***	28	20	◁—— 8 ——▷	
D****	26	16	◁—— 8 ——▷	
E***	22	18	12	6
F**	20	15	12	6
G****	25	18	◁—— 8 ——▷	
H**	22	18	12	6
Range	20-28	12-20	7-12	5-6
Mdn	23	17	+	+

Location

*East
**Midwest
***West
****South

+Insufficient data

Table II

TARGET AVERAGE SALARIES
1968-69 THROUGH 1970-71

Rank	1968-69 AAUP "A"-"AA" Midpoint	1968-69 Target Salary	1969-70 AAUP "A"-"AA" Midpoint	1969-70 Target Salary	1970-71 AAUP "A"-"AA" Midpoint	1970-71 Target Salary
Professor	$24,250	22,454	25,397	23,516	26,598	24,628
Assoc. Professor	14,500	13,426	14,842	13,743	15,192	14,067
Ass't. Professor	11,350	10,509	11,765	10,894	12,195	11,292
Instructor	8,650	8,009	8,994	8,328	9,351	8,658

Table III

FACTOR WEIGHTS BY LEVEL OF INSTRUCTION
IN THREE STATES

Levels of Instruction	A***	B**	C***
Lower Division	1.00	1.00	1.00
Upper Division	1.50	1.60	1.50
Graduate Professional Masters, and First Stage Doctoral	2.50	2.57	⇕ 3.00
Doctoral, Second Stage	3.50	3.45	

**Midwest

***Western

Table IV

THE APPLICATION OF RESOURCES
ACCORDING TO AREAS OF KNOWLEDGE
AND LEVELS OF INSTRUCTION

Areas of Knowledge (Selected)	Levels of Instruction			
	Lower Division	Upper Division	Masters Degree	Ph.D. M.D.
Biological Sciences				
Physical Science				
Social Sciences	"A"	"B"		
Humanities				
Fine Arts				

Figure A

CONCEPTUAL MODEL

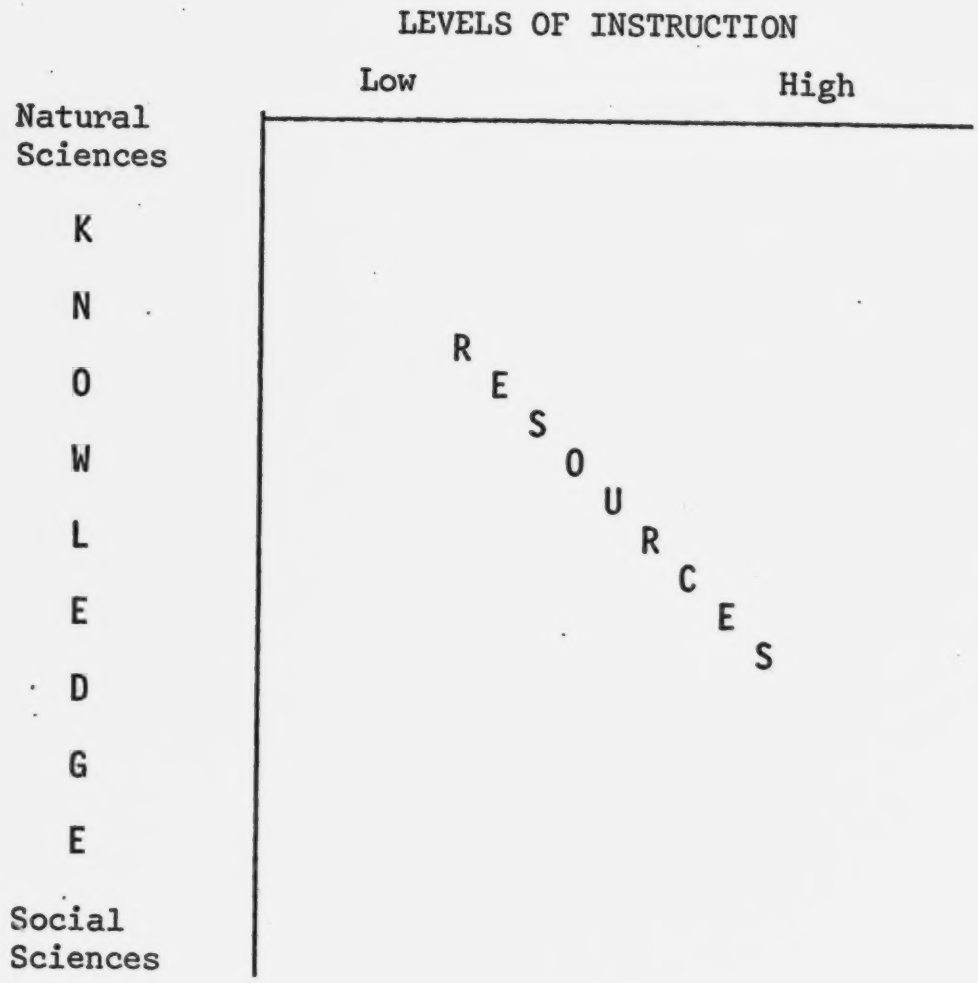

Figure B

DETAIL FOR CELL A

Departmental Instruction and Research

a. Faculty Compensation $378,000

Faculty Load: 360 student credit hours
Student Load: 15 credit hours
Total Student Credit Hours: 15,000
Total Faculty Required: 42
Average Faculty Compensation: $9,000

b. Faculty Support 94,500

Personal Services: $40,000
Supplies and Other: $44,500
Departmental Administration: $10,000

$472,500

Instructional Services ($30 per student) 30,000

Libraries (10% of departmental instruction) 47,250

Student Services ($80 per student) 80,000

General Expense ($45 per student) 45,000

Plant Operation ($100 per student) 100,000

Administration ($45 per student) 45,000

Total, Instructional and General Expenditure $819,750

Figure C

DETAIL FOR CELL B

Departmental Instruction and Research

a. Faculty Compensation	$787,500
Faculty Load: 240 student credit hours Student Load: 15 credit hours Total Student Credit Hours: 15,000 Total Faculty Required: 63 Average Faculty Compensation: $12,500	
b. Faculty Support	202,500
Personal Services: $80,000 Supplies and Other: $90,000 Departmental Administration: $32,500	
	$990,000

Instructional Services ($30 per student)	30,000
Libraries (10% of departmental instruction)	100,000
Student Services ($80 per student)	80,000
General Expense ($45 per student)	45,000
Plant Operation ($200 per student)	200,000
Administration ($45 per student)	45,000
Total, Instructional and General Expenditure	$1,490,000

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